PATENT APPLICATION

IN THE U.S. PATENT AND TRADEMARK OFFICE

March 26, 2004

Applicants: Hidenari YASUI et al

For: PROCESS AND APPARATUS FOR BIOLOGICAL TREATMENT OF AQUEOUS ORGANIC WASTES

Serial No.: 08/309 868 Group: 1761

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Atty. Docket No.: Yanagihara Case 28

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

APPELLANTS' BRIEF ON APPEAL

Sir:

This is an appeal from the decision of the Examiner, dated November 26, 2003, finally rejecting Claims 2-5 and 11-15.

REAL PARTY IN INTEREST

Kurita Water Industries, Ltd., the assignee of the present application, is the real party in interest.

RELATED APPEALS AND INTERFERENCES

There are no related appeals and interferences to the present application.

STATUS OF CLAIMS

Claims 2-5 and 11-16 are pending and are the claims on appeal. Claims 7-10 have been withdrawn from consideration as being directed to a non-elected invention. Claims 1 and 6 have been cancelled.

STATUS OF AMENDMENTS

An Amendment After Final Rejection dated March 26, 2004 is being filed concurrently with this Appeal Brief.

SUMMARY OF THE INVENTION

Appellants' invention, as defined in independent Claim 11, is directed to a process for the aerobic biological treatment of an aqueous organic waste. This process comprises the steps of introducing the aqueous organic waste into an aeration tank, aerating the aqueous organic waste in the aeration tank in the presence of a biosludge composed essentially of aerobic microorganisms to form an aerated aqueous suspension, withdrawing aerated aqueous suspension from the aeration tank and introducing it into a solid/liquid separation unit, subjecting the aerated aqueous suspension in the solid/liquid separation unit to solid/liquid separation to form a separated sludge containing the biosludge and a separated liquid phase, withdrawing the separated liquid phase from the process as treated water, recycling at least a portion of the separated sludge back to the aeration tank, ozonizing either aerated aqueous suspension withdrawn from the aeration tank or a part of the separated sludge, the ozonizing taking place at a pH of 5 or lower, and recycling either the ozonized aerated aqueous suspension or the ozonized part of the separated sludge back to the aeration tank for aerobic biological treatment (specification page 4, last two lines, through specification page 5, lines 1-21).

The present invention, as defined in Claim 2, limits Claim 11 in requiring that the ozonizing step be performed at a pH of 5 or lower by the addition of a pH controlling agent (specification page 10, lines 1-4).

The present invention, as defined in Claim 3, limits Claim 11 in requiring that the process further comprise, prior to the step of ozonizing, a step of acidogenesis in which a part of the aerated aqueous suspension in the aeration tank or the separated sludge is subjected to an anaerobic biological

treatment to adjust the pH thereof to a value of 5 or lower (specification page 10, lines 3-12).

The present invention, as defined in Claim 4, limits Claim 11 in requiring that the process further comprises a step of heating the aqueous suspension or the sludge to a temperature between 50 and 100°C before or after the ozonizing step (specification page 19, lines 1-13). The present invention, as defined in Claim 5, limits Claim 11 in requiring that the biosludge at the aeration tank have a VSS/SS ratio maintaining a value of 0.2-0.7 and an MLVSS value maintained of 500-10,000 mg/l (specification page 24, lines 2-5).

Appellants' invention, as defined by independent Claim 12, is directed to a process for aerobic biological treatment of an aqueous organic waste. This method comprises the steps of introducing the aqueous organic waste into an aeration tank, aerating the aqueous organic waste in the aeration tank in the presence of a biosludge composed essentially of aerobic microorganisms to form an aerated aqueous suspension, withdrawing aerated aqueous suspension from the aeration tank and introducing it to a membrane separation unit, subjecting the aerated aqueous suspension in the membrane separation unit to membrane separation to form a permeated liquid and a concentrated sludge containing the biosludge, withdrawing the permeated liquid from the process as treated water, recycling at least a portion of the concentrated sludge back to the aeration tank, ozonizing either aerated aqueous suspension withdrawn from the aeration tank or a part of the concentrated sludge, the ozonizing taking place at a pH of 5 or lower, and recycling either the ozonized aerated aqueous suspension or the ozonized part of the concentrated sludge back to the aeration tank for aerobic biological treatment (specification page 4, last two lines, through specification page 5, lines 1-21, and specification page 22, lines 23-27).

The present invention, as defined in Claim 13, limits Claim 11 in requiring that the amount of biosludge ozonized and converted into BOD components is greater than the amount

of excess sludge generated in the bioreactor (specification page 28, line 10, through specification page 29, line 8).

The present invention, as defined in Claim 14, limits Claim 12 in requiring that the amount of biosludge ozonized and converted into BOD components is greater than the amount of excess sludge generated in the bioreactor (specification page 28, line 10, through specification page 29, line 8).

The present invention, as defined in Claim 15, limits Claim 11 in requiring that aerated aqueous suspension withdrawn from the aeration tank is ozonized (specification page 5, lines 16-18).

The present invention, as defined in Claim 16, limits Claim 12 in requiring that aerated aqueous suspension withdrawn from the aeration tank is ozonized (specification page 5, lines 16-18).

ISSUES

The first issue presented for review is whether Claims 2, 5, 11, 13 and 15 are unpatentable under 35 USC 103 over Smith et al in view of Hei et al or Berndt or Kramer et al. The second issue presented for review is whether Claims 12, 14 and 16 are unpatentable under 35 USC 103 over Smith et al in view of Hei et al or Berndt or Kramer et al and further in view of Dorau et al. The third issue presented for review is whether Claims 3 and 4 are unpatentable under 35 USC 103 over Smith et al in view of Hei et al or Berndt or Kramer et al and further in view of Brock.

GROUPING OF CLAIMS

Claims 2-5 and 11-16 do not all stand or fall together. Claims 2-5, 11 and 12, Claims 13 and 14 and Claims 15 and 16 are all directed to separately patentable inventions.

ARGUMENT

The invention on appeal is directed to a process for the aerobic biological treatment of an aqueous organic waste. This process requires the aqueous organic waste to be introduced into an aeration tank where it is aerated in the presence of a biosludge composed essentially of aerobic microorganisms to form an aerated aqueous suspension, the aerated aqueous suspension withdrawn from the aeration tank and introduced into a solid/liquid separation unit where the aerated aqueous suspension is subjected to solid/liquid separation to form a separated sludge containing the biosludge and a separated liquid phase, the separated liquid phase withdrawn from the process as treated water, at least a portion of the separated sludge recycled back to the aeration tank, either aerated aqueous suspension withdrawn from the aeration tank or a part of the separated sludge ozonized at a pH of 5 or lower and either the ozonized aerated aqueous suspension or the ozonized part of the separated sludge recycled back to the aeration tank for aerobic biological treatment. A membrane separation unit can be used to perform the solid/liquid separation.

The inventive feature of the present invention resides in the reduction of the amount of excess sludge generated during an aerobic biological treatment process by using ozone to oxidatively reduce waste materials containing biosludge and the recycling of the oxidized waste material back into an aerator. That is, the present claims require that either a part of the separated sludge or aerated aqueous suspension withdrawn from the aeration tank be subjected to an ozone treatment at a pH of 5 or lower and that the ozonized aerated aqueous suspension or ozonized part of the separated sludge be recycled back to the aeration tank for further aerobic biological treatment. These steps enable the reduction of excess sludge generated in the aerobic biological treatment process. In fact, the amount of biosludge ozonized and converted into biodegradable components can be greater than

the amount of excess sludge generated in the bioreactor. It is respectfully submitted that the prior art cited by the Examiner does not disclose such a process.

The primary Smith et al reference discloses a method for treating sewage or other biodegradable waste materials and comprises an aerobic process in which a settlable sludge is formed, a part or all of the sludge is returned to a point in advance of the input of the aerobic process and a selected portion of the returned sludge subjected to the action of ultraviolet or other bactericidal rays for the biolysis of the bacteria in the portion. The portion is selected to meet the food requirements of an active aerobic bacteria in the aerobic process and so regulate it that substantially all of the biodegradable matter is consumed and only a relatively small quantity of sludge is removed to end disposal. This reference further discloses that other means of effecting biolysis such as electrolysis, ultrasonics, heat, low temperature, photochemistry, ozonation or other means which do not produce toxic byproducts inimical to the biological process may be employed.

Although the Smith et al reference discloses that ozonization can be employed to perform biolysis on separated sludge, this reference has no disclosure as to what pH the ozonization should be conducted at or that any advantage is gained by using ozonization as opposed to the other means of effecting biolysis, including the preferred method of using ultraviolet radiation. Therefore, this primary reference differs from the presently claimed invention in three aspects, i.e., it has no disclosure or suggestion that any advantage would be gained by effecting biolysis of the separated sludge at a pH of 5 or lower, it has no disclosure of ozonizing aerated aqueous suspension withdrawn from the aeration tank and there is no disclosure of the amount of biosludge being ozonized and converted into biodegradable components being greater than the amount of excess sludge generated in the bioreactor. Therefore, the secondary references cited by the

Examiner must provide these teachings. It is respectfully submitted that the secondary references contain no such teachings.

Hei et al discloses the use of a potentiated aqueous ozone cleaning composition to remove contaminating soil from a surface. Apparently this reference has been cited by the Examiner for the disclosure at column 3, lines 38-53, regarding solubility and instability of ozone at various pH levels. The fact that ozone may be more unstable at higher pHs has no correlation at all with respect to the reaction efficiency of ozone at the presently claimed pH range. Hei et al discloses that the decomposition of ozone is substantially enhanced as the pH increases past 6. As shown in Figure 16 of the present application, the reaction efficiency at pH 6 is much lower than the claimed upper limit of pH 5. As such, given the unexpectedly high efficiency at the presently claimed pH range of no higher than 5, the Hei et al reference clearly does not teach the presently claimed invention.

The Berndt reference discloses a reactor/sterilizer for disinfecting contaminated medical and/or biological waste and methods thereof. The Berndt reference apparently has been cited for its disclosure at column 4, lines 48-60, that ozone is more stable and more soluble in an aqueous solution as the temperature of the solution is reduced and at a pH less than about 9. As with the previously discussed Hei et al reference, the Berndt reference has no disclosure that would lead one of ordinary skill in the art to suspect that ozone would have an increased reaction efficiency at the claimed pH range of not greater than 5, as this reference only discloses that ozone in an aqueous solution is more stable at a pH of less than about 9. As such, Berndt adds nothing to the previously discussed references.

The Kramer et al reference is directed to glassy polymeric gas separation membranes and a process for producing these membranes. Apparently this reference was cited for its disclosure at column 41, lines 14-31, that when ozone is

dissolved in water, it behaves chemically like ozone in the gaseous phase as long as the water is at a relatively acidic pH and that at a high pH, a pH greater than 10, ozone is very rapidly destroyed. Like the previously discussed secondary references, Kramer et al has no disclosure with respect to the claimed pH range of not greater than 5 and improving the reaction efficiency of ozone in the treatment of biological sludge. As such, Kramer et al adds nothing to the previously discussed references.

The Dorau et al reference cited by the Examiner discloses a process for the biological purification of sewage in which the substances that are difficult to decompose biologically or are not biologically decomposable are separated and concentrated to form a concentrate and the concentrate is then treated physically and/or chemically and the treated or untreated concentrate subjected to a biological transformation. Alternatively, the concentrate can be separated from the sewage to be purified. In the embodiment of the Dorau et al reference illustrated in the drawing, sewage 1 is introduced into a bioreactor 3 for aerobic treatment and the aerobically treated sludge introduced into a membrane/ultrafilter 9 by a filter pump 8. In the membrane/ultrafilter 9, sludge is separated from filtrate and the sludge is either discarded from the system as excess sludge 13 or returned to the bioreactor 3 as sludge concentrate 12 (referred to as 9 in the figure). The filtrate or biologically purified sewage 11 or untreated sewage 14 are introduced into a filtrate basin 15/1 in which concentrating is carried out by supplying the sewage 16/1 to a membrane/nano-filtering device 19/1.

In stage 4 of Dorau et al, physical or chemical treatment of concentrates 29/1 and 29/2 are performed. It is to be noted that these concentrates are not the sludge which is either removed from the system as excess sludge 13 or returned to the bioreactor as sludge concentrate 12 (9). In the reactor basin 31, the concentrates 29/1 and 29/2 can be

subjected to chemical treatment, such as ozone treatment, and then reintroduced back into the bioreactor via charging pump 32. As stated previously, this reference does not show (1) the removal of a portion of an aerated aqueous suspension from the aeration tank, ozone treatment of the aerated aqueous suspension and the returning of the ozonized aerated aqueous suspension back to the aeration tank or (2) performing ozone treatment on part of the sludge formed from the subjection of the aerated aqueous suspension to solid/liquid separation and the returning of the ozonized part of the concentrated sludge back to the aeration tank for further aerobic biological treatment.

Additionally, the present invention requires that the ozone-treatment of the sludge or aerated aqueous suspension be performed at a pH of 5 or lower. Dorau et al has no disclosure with respect to the pH range at which the contents of reactor basin 31 are subjected to ozone treatment. As shown in Figure 16 of the present application, when the pH is adjusted to be between 3 and 5 prior to the ozone treatment, a much lower amount of ozone is needed to accomplish the desired oxidation. This is clearly unexpected in light of the disclosure of Dorau et al and the other references cited by the Examiner.

The Brock reference has been cited by the Examiner for the "well known effect of microorganisms on the pH". Appellants readily admit that microorganisms involved in fermentation are more likely to lower than to raise the pH of their environment. However, since the present invention is not dealing with anaerobic fermentation, Appellants are hard-pressed to see how this reference is relevant to the presently claimed invention.

In the present invention, it is essential that the withdrawn aerated aqueous suspension or the separated sludge be ozonized at a pH of 5 or lower. While the secondary Hei et al, Berndt and Kramer et al references disclose that ozone tends to decompose at higher pHs in an aqueous solution, these

references contain no disclosure with respect to any relationship between ozone reactbility and pH in an aqueous biosludge suspension containing living cells of microorganisms. As such, there is no basis for attempting to transfer the teachings regarding the effect of pH of ozone stability in an aqueous solution to choosing the pH under which an aqueous biosludge suspension is ozonized.

It is well known in the art that the higher the pH of an aqueous biosludge suspension, the greater the ozone-reaction rate. As such, the optimum ozone reaction rate for preventing the generation of excess sludge to be disposed on can vary in accordance with each specific pH value and, in general, ozone treatment is performed in the neutral pH range. The present invention is based on the discovery that when a biosludge is subjected to ozone treatment, polysaccharides decompose oxidatively into BOD components so that the cells are destroyed and the proteins flow out of the cells and then are subject to react with the ozone in the system. When the proteins react with the ozone, an excessive amount of ozone is required for complete transformation of the polysaccharides into biodegradable components since the proportion of ozone reacting with the polysaccharides decreases correspondingly. The present inventors discovered that if, at this point in time, the ozone treatment is carried out at a pH of 5 or lower, the reaction of ozone with proteins will lessen due to the possible coagulation of the proteins in the acidic medium. Therefore, the efficiency of the reaction of ozone with the polysaccharides is increased with the result that more polysaccharides are oxidatively decomposed at a lower ozone dose.

This is shown in Examples 1 and 2 in the present specification, as well as in Comparative Examples 1 and 2. The amount of excess sludge formed at a pH of 5 is less than that formed at a pH of 7 which evidences the reduction in the excess sludge formation at pH 5 as opposed to that at pH 7. Additionally, Figures 16 and 17 of the present specification

show that when the pH is 5 or lower, the ozone dose to effect the equivalent amount of transformation of the sludge into BOD components is about ½ to that required at a pH of 6. This is clearly unexpected in light of the prior art cited by the Examiner and establishes the patentability of Claims 2, 5, 11, 13 and 15 thereover.

Claims 13 and 14 require that the amount of biosludge ozonized and converted into BOD components is greater than the amount of excess sludge generated in the bioreactor. As discussed on specification page 20, line 18, through specification page 21, line 9, by withdrawing an amount of biosludge from the aeration tank at least corresponding to that formed in the aerobic biological treatment and treating it by ozonization before returning it back to the aeration tank, it is possible to reach "zero amount" of excess sludge formed in the overall reaction. None of the references cited by the Examiner speak to reaching such a "zero amount" by insuring that the amount of biosludge ozonized and converted into BOD components is greater than the amount of excess sludge generated in the bioreactor. As such, it is respectfully submitted that Claims 13 and 14 are separately patentable over the prior art cited by the Examiner.

Claims 15 and 16 are also separately patentable over the prior art cited by the Examiner in that they require that aerated aqueous suspension withdrawn from the aeration tank be ozonized. Since the primary Smith et al reference and the secondary Dorau et al reference, which are the only references dealing with aerobic biodegradation of sludge, only disclose separated sludge being subjected to ozone treatment, the requirement in Claims 15 and 16 that the aerated aqueous suspension withdrawn from the aeration tank be ozonized clearly is not shown by any of the references cited by the Examiner and is patentably distinguishable over the cited prior art.

It appears that the Examiner refuses to consider the limitations recited in Claims 13-16,

> "because the Markush member directed to ozonating separated sludge has been selected as the member to be prosecuted and because said member is anticipated by the prior art, it is considered that the new dependent claim limitations are fully met. Specifically, as is current Patent Office practice, where the selected member of a Markush group is anticipated, any limitations directed to other Markush members in the same or different claims are not considered to add any further limitations to the rejected claims. Dependent claims limitations are incorporated into the independent claim (from which they depend) and, as such, they are read as alternative limitations that are not being prosecuted. Therefore, these claims and their alternative limitations are anticipated."

While Appellants are not entirely clear as to what the Examiner means in the above-recited quotation, regardless of what current Patent Office practice is as proposed by the Examiner, case law states that Applicants act of originally claiming the Group A, B, C, and D together cannot support a finding of obviousness. The Applicants' own finding of functional equivalency is not prior art.

> "The mere fact of their having being claimed together fails to show any equivalency other than the functional equivalency discovered and first disclosed by Applicants. Reliance thereon for rejection involves a fallacy ... the Applicants teaching is assumed to be the prior art."

> "To sum it all up, actual equivalence is not enough to justify refusal of a patent on one member of a group when another member is in the prior art. The equivalence must be disclosed in the prior art or be obvious within the terms of Section 103."

In re Ruff, 256 F2d 590, 118 USPQ 340 (CCPA 1958).

With respect to the "Markush group" rejection posited by the Examiner, Appellants wish to point out to the Examiner that a rejection under 35 USC 102 has not been made and, therefore, the Examiner's discussion with respect to anticipation is not understood. Moreover, "Patent Office practice" as enunciated by the Examiner does not supercede case law and, as such, the limitations of Claims 13-16 have to be considered individually during their examination.

CONCLUSION

For the reasons discussed above, the Examiner's rejection of the currently pending claims over the cited prior art clearly is in error. Reversal of the Examiner is respectfully solicited.

Respectfully submitted,

IN TRIPLICATE

Terryence F. Chapman

TFC/smd

FLYNN, THIEL, BOUTELL & TANIS, P.C.	Dale H. Thiel	Reg. No. 24 323
2026 Rambling Road	David G. Boutell	Reg. No. 25 072
Kalamazoo, MI 49008-1631	Ronald J. Tanis	Reg. No. 22 724
Phone: (269) 381-1156	Terryence F. Chapman	Reg. No. 32 549
Fax: (269) 381-5465	Mark L. Maki	Reg. No. 36 589
	Liane L. Churney	Reg. No. 40 694
	Brian R. Tumm	Reg. No. 36 328
	Steven R. Thiel	Reg. No. 53 685
	Sidney B. Williams, Jr.	Reg. No. 24 949

Encl: Appendix
Amendment After Final Rejection
Postal Card

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APPENDIX

11. (Currently Amended) A process for aerobic biological treatment of an aqueous organic waste comprising the steps of:

introducing the aqueous organic waste into an aeration tank;

aerating the aqueous organic waste in the aeration tank in the presence of a biosludge composed essentially of aerobic microorganisms to form an aerated aqueous suspension;

withdrawing aerated aqueous suspension from the aeration tank and introducing it into a solid/liquid separation unit;

subjecting the aerated aqueous suspension in the solid/liquid separation unit to solid/liquid separation to form a separated sludge containing the biosludge and a separated liquid phase;

withdrawing the separated liquid phase from the process as treated water;

recycling at least a portion of the separated sludge back to the aeration tank;

ozonizing either aerated aqueous suspension withdrawn from the aeration tank or a part of the separated sludge, the ozonizing taking place at a pH of 5 or lower; and

recycling either the ozonized aerated aqueous suspension or the ozonized part of the separated sludge back to the aeration tank for aerobic biological treatment.

2. (Currently Amended) A process according to Claim 11, wherein the ozonizing step is performed at the pH of 5 or lower by an addition of a pH controlling agent.

3. (Currently Amended) A process according to Claim 11, wherein the process further comprises, prior to the step of ozonizing, a step of acidogenesis in which a part of the aerated aqueous suspension in the aeration tank or the separated sludge is subjected to an anaerobic biological treatment to adjust the pH thereof to a value of 5 or lower.

4. (Currently Amended) A process according to Claim 11, wherein the process further comprises a step of heating the aqueous suspension or the sludge to a temperature between 50 and 100°C before or after the ozonizing step.

5. (Previously Presented) A process according to Claim 11, wherein the biosludge in the aeration tank has a VSS/SS ratio maintained at a value of 0.2 - 0.7 and a MLVSS value maintained of 500 - 10000 mg/l.

12. (Currently Amended) A process for aerobic biological treatment of an aqueous organic waste comprising the steps of:

introducing the aqueous organic waste into an aeration tank;

aerating the aqueous organic waste in the aeration tank in the presence of a biosludge composed essentially of aerobic microorganisms to form an aerated aqueous suspension;

withdrawing aerated aqueous suspension from the aeration tank and introducing it into a membrane separation unit;

subjecting the aerated aqueous suspension in the membrane separation unit to membrane separation to form a permeated liquid and a concentrated sludge containing the biosludge;

withdrawing the permeated liquid from the process as treated water;

recycling at least a portion of the concentrated sludge back to the aeration tank;

ozonizing either aerated aqueous suspension withdrawn from the aeration tank or a part of the concentrated sludge, the ozonizing taking place at a pH of 5 or lower; and

recycling either the ozonized aerated aqueous suspension or the ozonized part of the concentrated sludge back to the aeration tank for aerobic biological treatment.

13. (Previously Presented) The process according to Claim 11, wherein the amount of biosludge ozonized and converted into BOD components is greater than the amount of excess sludge generated in the bioreactor.

14. (Previously presented) The process according to Claim 12, wherein the amount of biosludge ozonized and converted into BOD components is greater than the amount of excess sludge generated in the bioreactor.

15. (Currently Amended) The process according to Claim 11, wherein aerated aqueous suspension withdrawn from the aeration tank is ozonized.

16. (Currently Amended) The process according to Claim 12, wherein aerated aqueous suspension withdrawn from the aeration tank is ozonized.